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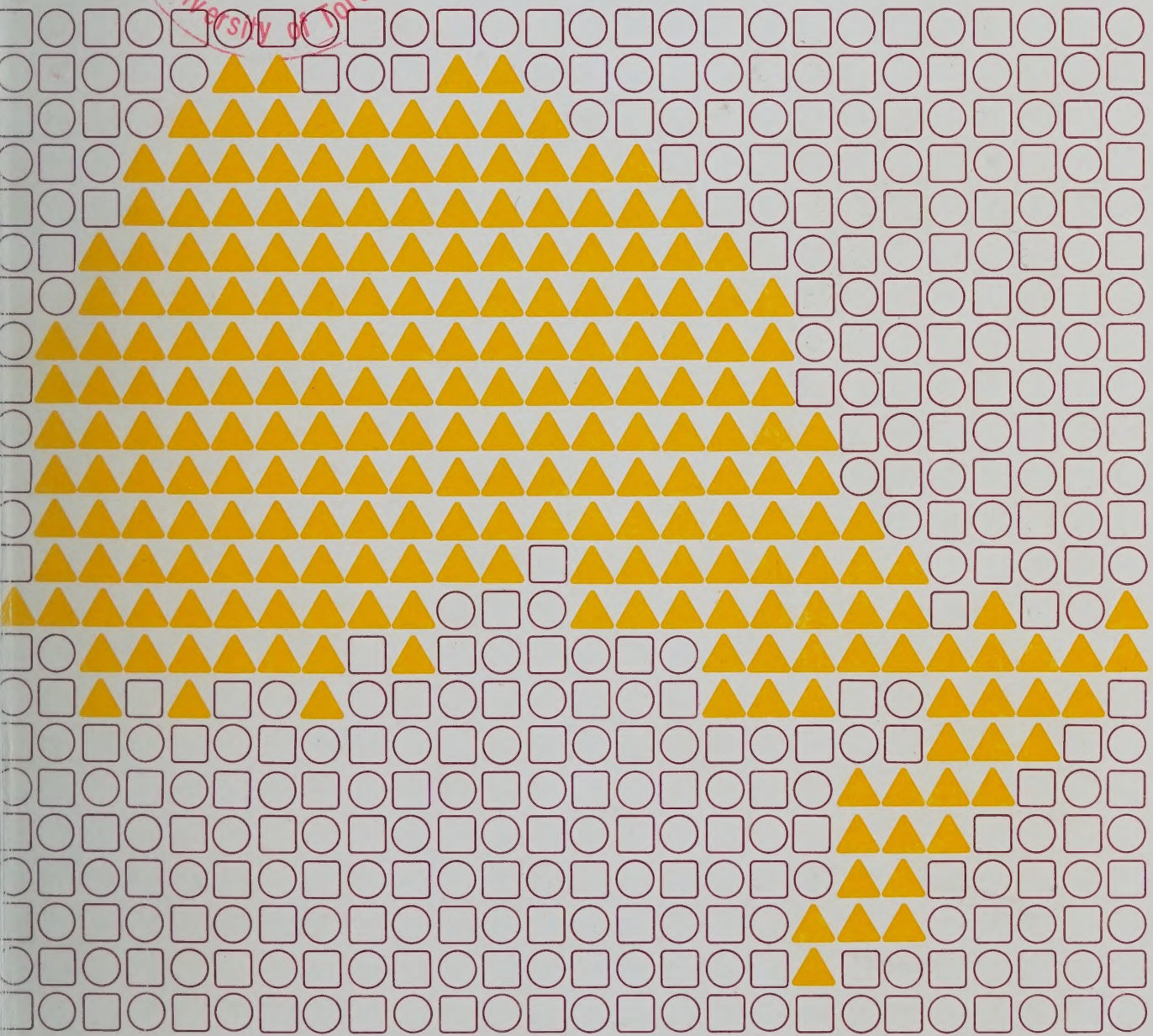
Volume 11, Number 1, Winter 1990

Construction Safety in Ontario

Hepatitis B: Implications for Health Care Workers

Preventing and Dealing with Mass Psychogenic Illness

Nuclear Emergency Planning and Response



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Occupational Health in Ontario

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3. U.S. Department of Health, Education and Welfare. Smoking and Health. A report of the U.S. Surgeon General, 1979.

Dmytro Pizak, M.A.Sc., P.Eng.

Construction Safety in Ontario*

Summary

A compilation of statistics covering the period 1966–87 shows where, how and when construction accidents in Ontario are happening. Recording and investigating such data are key activities in any safety program. Methods of measuring construction safety are discussed, along with figures showing that the province's construction workers are safer at work today than in the past.

Keywords: construction, safety, accident statistics

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Introduction

Improving the safety of construction workers in Ontario has been a continuing goal of the Ministry of Labour for several decades, particularly since the establishment of the Construction Safety Branch in 1962. A compilation of accident statistics covering the period 1966–87 shows that Ontario's construction workers are safer at work today than they have ever been. By both standard measurements of worker safety — fatalities per 100,000 workers, and lost-time injuries per million hours worked — Ontario's construction industry has, on average, become consistently safer since 1966. As well, Ontario's construction safety record is one of the best, if not *the* best, of the 10 Canadian provinces, and it compares favourably both with the United States and with such European countries as France and Sweden.

The overall improvement in Ontario's safety record has occurred over a period when the construction work force has grown, its makeup has changed, and the average annual person-hours worked have shown a steady increase. Today we know more about what happens, and how, when and where accidents are likely to occur in the construction industry, than we did in the past. Recording and investigating accidents are key activities in any safety program: if accidents are to be reduced, we have to know exactly what accidents are happening, and when and where they are taking place.

For example, we know that a construction worker who injures his or her back lifting a heavy object while building a house on a Monday is statistically in the largest injury group. Conversely, we know that another worker who reacts to a toxic insect bite while clearing bush on a Friday is statistically in the smallest group. In between lies a whole range of accidents, injuries, causes and locations, and days on which all these occur. This statistical tracking of accidents, their causes

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and the circumstances surrounding them, allows us to administer properly the legislation relating to the industry, and to advise employers how and where they need to reduce risk to workers.

Working for Safety

Ensuring the safety of construction workers on the job in Ontario is a co-operative effort involving government, safety associations, contractors, unions and individual construction workers. Particularly, the Occupational Health and Safety Education Authority (OHSEA) of the Workers' Compensation Board (WCB), the Construction Safety Association of Ontario (CSAO), the Council of Ontario Contractors' Associations (COCA), the Electrical Utilities Safety Association of Ontario (EUSA), the workers' training centres, and the Provincial Labour-Management Health and Safety Committee deserve special mention.

Co-ordinate Efforts

The Construction Health and Safety Branch (CHSB) of the Ontario Ministry of Labour works with these organizations to co-ordinate their efforts on behalf of the construction workers of Ontario.

According to the CHSB operations manual, 'The objective of the branch is to administer the Occupational Health and Safety Act and applicable regulations in the construction, diving and window cleaning industries and to encourage employers and workers in those industries to cooperatively identify and control health and safety hazards.'

Today's construction safety legislation, and the mechanisms in place to enforce it and to encourage an industry-wide effort to improve working conditions, have their roots in legislation dating from just after the turn of the century. In 1911, Ontario passed its first bill to protect construction workers: the *Building Trades Protection Act*. This was followed by the Underground Work Regulation of 1926, which contained measures to protect construction workers in shafts, tunnels, caissons, cofferdams and compressed air work.

New Legislation

In 1954, the *Trench Excavators' Protection Act* prescribed safety standards for workers in sewer and watermain operations, and was followed a year later with a set of specific regulations. Each of these pieces of legislation was enforced by individual municipalities.

This practice continued until 1960, when two particularly bad accidents occurred and focused public attention on construction safety. The first was the 'Hogg's Hollow Disaster,' in which five workers were killed in a fire in an underground tunnel in Metropolitan Toronto. The second was a major collapse of formwork during construction of Toronto's Bloor-Danforth subway line, resulting in the deaths of three workers.

Royal Commission

The provincial government set up a royal commission under Judge P.J. McAndrew to investigate construction operations across the province. In 1962, in response to Judge McAndrew's recommendations, the government promulgated the *Construction Safety Act*. In the same year, the Construction Safety Branch of the Ministry of Labour was established, with a mandate to monitor the enforcement by municipalities of both the *Construction Safety Act* and the *Trench Excavators' Protection Act*. The branch was empowered to offer advice and assistance to municipalities; at that time, the branch's only enforcement responsibility was for the Underground Work Regulation.

A major recommendation of the McAndrew commission was the consolidation of the aforementioned pieces of legislation into one comprehensive act. It was not until 11 years later, however, that this consolidation actually took place. On August 1, 1973, the *Construction Safety Act* (1973) was promulgated. It included the provisions of the *Construction Safety Act* (1962), the *Trench Excavators' Protection Act*, and the Underground Work Regulation. Responsibility for enforcing the Act was given to the Province. With this transfer of responsibility, municipal safety inspectors were invited to join the newly created Construction Safety Branch. Most accepted, and, when recruitment was completed, the branch's inspectorate had increased from 27 to 90.

Tumultuous Early Years

The first three years — 1973 to 1975 — were tumultuous. The major activities of the branch during that period were inspections, the issuing of written orders, stop-work orders, consultation and prosecution. Construction employers, unaccustomed to regular inspections, offered a great deal of resistance. In many cases, compliance with the Act was obtained only after prosecution procedures were begun. On May 1, 1975, sec-

tion 31 of the *Construction Safety Act* was amended to make mandatory the registration of every construction employer in the province.

After the Province assumed responsibility for enforcing the Act, there was a significant reduction in fatal accidents on Ontario's construction sites. The highest number, 72 fatalities, was recorded in 1966, when municipalities still had responsibility for enforcement and had made a reported 200,000 inspections. This fatality rate was 35.5 per 100,000 workers. By comparison, the highest number recorded under provincial responsibility was 45, in 1974, or 19.6 per 100,000 workers. In that year, the Province made 60,000 inspections.

Up to 1975, the Construction Safety Branch emphasized the elimination of safety hazards on construction sites and paid attention to certain health hazards, including asbestos and silica. In 1976, however, the *Employees' Health and Safety Act* was proclaimed; it introduced two major changes to the safety scene:

1. It gave employees the right to refuse unsafe work.
2. It introduced workplace safety committees in legislation — although, at the time, on a voluntary basis.

Two years later, the *Occupational Health and Safety Act* (the Act) and Regulations for Construction Projects were promulgated, leading to the creation of an Occupational Health and Safety Division within the Ministry of Labour. There followed a consolidation within the Construction Health and Safety Branch of responsibility for a number of different regulations. In early 1984, for instance, a regulation governing the health and safety of workers in the window-cleaning industry was promulgated, and the branch assumed responsibility for enforcing it. In March 1986, the branch assumed responsibility for the regulation on asbestos on construction projects, and in buildings and repair operations.

New Regulations

In January 1987, the Regulation for Diving Operations was proclaimed under the Act, and the branch assumed responsibility for its administration and enforcement. In August 1988, the Regulation for Window Cleaning was amended, and the Regulation on Roll-Over Protective Structures was decreed. Again, the Construction Health and Safety Branch assumed responsibility.

As well as enforcing legislation, the branch has an ongoing process of developing regulatory initiatives and training programs for its inspectors. These training

programs are intended to improve the ability of inspectors to identify hazards and to recommend procedures to the construction industry to reduce them.

Fluctuating Inspectorate

Over the years, the CHSB inspectorate has fluctuated in numbers — from 91 in 1977, to 67 in March 1985. With a reduction in the number of inspectors came a corresponding reduction in the number of inspections. Both labour and management in the construction industry pointed to this trend as a contributing factor in the number of injuries, and as a result approval was obtained for additional inspection staff. By the end of 1988, the number of field inspectors stood at 97.

Today, Ontario has an improving record of reducing hazards and injuries in the construction industry. This record is due in part to the activities of the Construction Health and Safety Branch. The bulk of the credit, however, must go to the industry itself, and to the activities of the construction unions, safety-conscious employers, and the various safety organizations across the province that are now working in partnership with labour, management and the government to make Ontario's construction industry as safe as possible.

Measuring Performance

There are two main methods of measuring safety in the construction industry. The first is by measuring the number of fatalities that occur in a year, as a ratio per 100,000 workers in the industry. The second is by measuring the number of injuries resulting in workers losing time from work, as a ratio per million person-hours worked.

Although different organizations studying worker health and safety tend to favour one or the other measure as the standard for determining performance, neither alone is entirely adequate. Taken together, however, they can show trends in both the number of injuries occurring and the severity of the injuries themselves. In both cases — rate of fatalities and lost-time injury frequency — Ontario shows an improvement over the last 22 years.

The most notable change in Ontario's construction work force in the last 13 years has been in its size. Since 1975, it has grown from a total of 217,000 workers to 308,000 in late 1987. These figures do not have a direct correlation with accident figures; they are, however, an indication of both the dynamic nature

of the construction industry in Ontario and the changes we are seeing in the work force.

Construction Boom

The mid-1980s have seen a boom in residential construction in Ontario — the largest since the late 1960s — with a resulting increase in the work force; trends in fatality rate and lost-time injury frequency reflect this concentration of construction effort.

How Ontario Compares

1966–1987

In 1966, construction workers in Ontario worked in excess of 302 million person-hours. They also recorded 20,190 lost-time injuries (LTIs), for a frequency rate of 66.7 LTIs per million person-hours worked.

In 1987, person-hours had increased to more than 372 million, but LTIs had *dropped*, in absolute figures, to 17,460, and, as a frequency rate, to 46.9.

Over that period, person-hours fluctuated by as much as 116 million a year (364 million person-hours in 1974, 248 million in 1983); generally, as person-hours increase, LTIs also increase. As a measurement of overall safety, the important figure is the frequency rate, which in spite of these fluctuations has steadily decreased since 1966 from 66.7 and now sits generally around the 50 mark (46.9 in 1987). Since the Ministry of Labour assumed responsibility for inspection in August 1973, the rate has fluctuated between 46.9 and 55.8, for an average of 50.5.

Ontario's record has also improved in terms of rate of fatalities on the job. In 1966, with 202,900 workers, there were 72 deaths as a result of accidents on construction sites, for a fatality rate of 35.5 per 100,000 workers.

In 1987, with 307,860 workers, there were 42 fatalities — again, a decrease in absolute terms as well as in relative terms (13.6 fatalities per 100,000 workers).

As with LTI statistics, the figures fluctuate from year to year, depending on the amount of construction under way and the number of people working. If we were to look at a graph that charts progress on a year-to-year basis, we would see, however, that on average the trend is down. Ontario has reduced its fatality rate on construction sites by an average of 0.5 fatalities per 100,000 workers every year since the branch assumed responsibility in 1973.

With Other Provinces and the World

The Construction Safety Association of Ontario (CSAO) compiles statistics on the construction industry in Canada, measuring the LTI rate per 100 workers at risk — a slightly different approach from the one the Ministry of Labour has traditionally used. These figures, covering 1975 to 1986, show that Ontario has, with one exception, consistently had the lowest LTI rate in Canada.

The exception is the 12-year average for Nova Scotia. Nova Scotia uses a different method of classifying LTIs: an injury only becomes an LTI in Nova Scotia *after* three workdays have been lost; in Ontario (and every other province), an injury becomes an LTI as soon as *any* worktime is lost.

In all probability, Ontario has the best construction safety record in the country, measured in LTIs per 100 workers at risk, over the 13-year measurement period. It should also be noted that nationally the general trend is down. Across the country, construction sites are becoming safer.

It is interesting to note that, internationally, Ontario's record also compares favourably. According to CSAO figures, in 1986, Ontario's LTI rate per 100 full-time employees was 5.4, compared to 6.9 in Sweden (1984 figures), 9.9 in the United States, and 12.4 in France. The same year, Ontario's fatality rate per 100,000 workers was 13.3, compared to 12.1 in Sweden (1984), 21.4 in France, and 33.0 in the United States.

Where Accidents Are Happening

Until 1980, most statistics regarding accidents in the construction industry were obtained from provincial compensation boards, such as Ontario's Workers' Compensation Board. Because of the nature of these boards, most of this information is related to compensation matters, such as the nature of the injury.

In 1978, CSAO introduced a new data system, which compiled all information relevant to an injury, including immediate and underlying causes, time of accident, tools involved, materials, procedures and so on. These data were then available for analysis, which would lead to a determination of what caused the accident and what could be done to prevent further such accidents.

Analysis of construction accidents in Ontario since 1981 reveals that, consistently, more injuries occur in residential construction than in any other single area, representing 16 per cent of the total in 1981 and 25 per cent in 1986.

Light commercial/industrial building has produced the second highest totals over the same period (14–16 per cent), followed by yard work, heavy industrial building, high-rise construction, institutional building, roads, and sewers and watermain construction.

This should not be taken to mean that low-rise residential construction is inherently more dangerous than putting in a sewer; the greater numbers could be merely a reflection of more activity in that area, with greater numbers of people putting in more person-hours.

Housing Construction Boom

It is interesting to note that as a percentage of LTIs in construction, residential building has increased its percentage since 1981, while the other areas have remained relatively steady. This pattern may well be a reflection of the housing construction boom in Ontario, and the entry of insufficiently trained workers into the industry.

Statistics Canada recently released figures for 1986 on LTIs across the country and in every industry. Those figures revealed an LTI rate of 8.5 per 100 workers. Figures for 1986 for Ontario's construction industry, revealing an LTI rate of 5.4 per 100 workers, are better than the national average.

What Happens

Injuries to the back and spine are, statistically, the most common of all, representing 25 per cent of the total construction injuries in Ontario in 1986. National figures from Statistics Canada show that back injuries account for 27 per cent of LTIs nationwide.

By comparison, the second most-injured part of the body is the finger, at 7.3 per cent, with frequency of injuries declining in order through the knee (6.5 per cent), ankle (5.6 per cent), shoulder (5.2 per cent), hand (5.2 per cent) and so on, down to the digestive system (statistically 0.0 per cent).

How It Happens

The three major types of accidents on construction sites are overexertion (25.5 per cent), being struck by an object (22.2 per cent) and falls (20.1 per cent). These three account for two-thirds of all accidents, with no other single cause accounting for more than 8 per cent. Specific causes of these accidents vary. The most frequent cause, at 13.3 per cent, is lifting excessive weights, followed by loss of footing, at 10.4 per cent.

The fourth-largest cause of injury is perhaps the easiest to prevent: 5.4 per cent of all injuries in Ontario in 1986 were caused by a lack of protective equipment being worn — again, perhaps, an indication of lack of training or supervision.

When It Happens

The statistics gathered by CSAO for the period 1981-86 also reveal on which days of the week most accidents occur on construction worksites. More accidents (22.6 per cent) happen on Mondays than on any other single day.

Tuesday accounts for the second-largest percentage (20.0 per cent), Wednesday is third (19.3 per cent), and Thursday fourth (17.7 per cent). Statistically, Friday is the safest normal workday, accounting for only 15.2 per cent of construction LTIs. Saturday and Sunday account for 3.2 and 1.2 per cent respectively.

While a number of explanations have been offered for this phenomenon, nothing conclusive has been established. It could be assumed, however, that it is the result of lack of concentration early in the week; one construction employer responded by shifting his weekly safety meeting from Fridays to early Mondays, with a resulting reduction in accidents.

Résumé

L'ensemble des statistiques pour la période de 1966 à 1987 montre où, comment et quand les accidents se produisent dans la construction en Ontario. Enregistrer et analyser ces données sont des activités primordiales pour tout programme de sécurité. Cet article discute de méthodes utilisées pour évaluer la sécurité dans la construction et cite des chiffres qui montrent que la sécurité des travailleurs du bâtiment dans la province est plus grande qu'autrefois.

Albert C. Strickler, M.D.

Hepatitis B: Implications for Health Care Workers

Summary

Hepatitis B is a known occupational risk for health care workers, particularly in clinical and laboratory areas. Safe and effective vaccines are available, but many health care workers remain unimmunized and susceptible. It is recommended that serologic evidence of protection, either by vaccination or natural infection, become a pre-admission requirement for all students entering health care programs.

Key Words: Hepatitis B, vaccine, health care worker

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Introduction

The term *hepatitis* means inflammation of the liver; it provides no information as to the cause.

Hepatitis may result from excess use of alcohol, and it can occur as a side effect of drugs such as INH, commonly used in the treatment of tuberculosis. Even viral hepatitis requires clarification of the etiologic agent. We recognize the hepatitis A virus (HAV), the hepatitis B virus (HBV) and the hepatitis D virus (delta agent). The viruses responsible for non-A, non-B hepatitis (NANBH) have been characterized just recently. They are the hepatitis C virus (HCV), associated with parenteral/post-transfusion transmission, and hepatitis E virsus (HEV), which is linked to enterically transmitted NANBH. In addition, hepatitis may be associated with other viral infections, such as infectious mononucleosis (E-B virus), cytomegalovirus (CMV) and herpes simplex virus (HSV). It will be clear, therefore, that the mere history of 'hepatitis' in a patient or on a laboratory specimen is not very helpful in determining the risk to which health care workers may be exposed.

While the viral causes of hepatitis may be numerous, it is hepatitis B that has, for many years, been the greatest concern to health care workers. In 1951, Trumbell and Greiner reported 16 cases occurring among hospital personnel in Memphis, Tennessee, over a period of three years.[1] At that time, the condition was called homologous serum jaundice, and Trumbell and Greiner reported cases occurring in blood bank and laboratory staff, as well as in operating room nurses, dentists, surgeons and pathologists. Even though 90 per cent of HBV infections recover completely, the other 10 per cent remain infected. These persons become chronic carriers, with or without persistent liver dysfunction and pathology as well as clinical unwellness. They face, too, the long-term risk of developing cirrhosis and hepatocellular carcinoma. Although rare, fulminant hepatitis B does occur and may result in death in a matter of days.

Serology

Any meaningful discussion of hepatitis B requires at least some knowledge of the serologic markers associated with the virus. The HBV is unique in that it has three sets of antigen-antibody systems. The first set is the surface antigen (HBsAg) and its surface antibody (anti-HBs). The second pair consists of the core antigen (HBcAg) and its antibody (anti-HBc). Finally, there is the 'e' antigen (HBeAg) and the corresponding antibody (anti-HBe).

While these may seem formidable to the infrequent user, they can be reduced to fairly simple and specific meanings. For one thing, the core antigen does not reach the serum and therefore cannot be demonstrated by serology. The hepatitis B surface antigen (HBsAg) is the infectious particle, and its presence in the serum means that the blood and other body substances of that person are infectious. This is the marker that health care workers must recognize as alerting themselves to risk. The surface antibody (anti-HBs) is just the opposite: it is the marker of resolution of HBV infection and the development of protective antibody. These two markers are essential to the understanding of the risk of transmission from a person with a history of hepatitis B.

The core antibody (anti-HBc) has no protective effect and merely indicates that replication of the HBV has occurred. This marker may be seen early in the infection, as the IgM form, and it may continue long after the clinical illness has resolved in the IgG form. The 'e' antigen (HBeAg) is a marker of increased infectiousness and means that the risk of transmission is greater than that from the HBsAg alone. The 'e' antibody (anti-HBe) indicates that the person has cleared the 'e' antigen, but, like anti-HBc, it is not an expression of protection. Only the development of anti-HBs ensures that the HBV infection has resolved and that the person has developed protection against future exposure.

All these markers appear sequentially during the course of HBV infection and may persist in various combinations. Proper interpretation of the serology will establish whether the HBV infection has cleared, thereby posing no risk to health care workers; or whether the infectious elements have persisted, wherein the person becomes a carrier and does present a risk in the health care setting.

Most of the information on the risk of HBV infection in health care workers comes not from the collection of cases, as in the Memphis study, but from sero-

prevalence surveys of various occupational populations, usually testing for the presence of surface antibody (anti-HBs). The literature contains many such studies, most of them undertaken in the 1970s and early 1980s in North America and in Europe. For example, at a university clinic in West Germany, anti-HBs was found in 16.1 per cent of 1,815 staff.[2] This is more than twice the prevalence of anti-HBs in West German blood donors, who reflect the background presence of HBV infection in the community. In the same study, 36 per cent of laboratory technologists were positive for anti-HBs, and the subgroup of laboratory technologists over age 30 showed a 60 per cent seropositivity for surface antibody. These data imply a correlation not only with the handling of blood and body substances in the laboratory, but also with the age and duration of technologists doing this work. Numerous other studies involving such health care groups as anaesthetists, surgeons, nurses and paramedics have demonstrated an increased prevalence of anti-HBs compared to the general population in the community. Seroprevalence data at Toronto General Hospital prior to the introduction of hepatitis B vaccine in 1983 showed that 13 of 37 technologists in clinical biochemistry (35 per cent) were anti-HBs positive, as were 26 per cent of hematology technologists.

Transmission

Transmission of HBV infection in the health care setting is primarily from patients and their body substances, particularly blood, to health care workers. While transmission in the opposite direction has occurred, i.e. from workers to patients, it is much less frequent. Such clusters have been documented in oral surgery settings, for example, involving multiple patient activity, bloody procedures and inadequate infection control practices.[3] Health care workers infected with the HBV (carriers) do not pose any significant risk to patients, even during surgical or invasive procedures, and should not be excluded from such work.[4] They must, of course, be knowledgeable about their carrier state and adhere rigorously to practices whereby their own infectious body substances can be contained. These practices include taking meticulous care of their skin as well as using protective barriers, such as gloves, appropriate to the situation. Where HBV-infected body substances are present in the health care workplace, the risk of infection for workers is considerable and may be as high as 25 to 30 per cent. Indeed, this risk of HBV infection is

far greater than the comparable risk for infection with the human immunodeficiency virus (HIV), which causes AIDS. It is fortunate that most HBV infections resolve completely and many of them remain subclinical, with the only evidence being the development of surface antibody (anti-HBs). A paradox continues, however, in that health care workers are far more fearful of HIV infection through worker–patient interaction — a situation that, until now, has not been documented in Canada. Meanwhile, many health care workers continue to ignore the availability of a safe and effective vaccine that provides protection against HBV infection.

Vaccine Programs

Since the development of the first hepatitis B vaccine in the early 1980s, the focus has been on vaccination of various populations at risk, with a view to obtaining the greatest protection for the considerable cost. Strategies have included post-exposure vaccination, serologic screening and vaccination of persons shown to be susceptible, vaccination of groups at risk without screening and vaccination of the community population. Strategies were influenced, too, by vaccine cost along with the expectation that demand for the vaccine might exceed the supply. In fact, there was a degree of resistance by health care workers, including physicians, to the original plasma-derived vaccine because of fears that the vaccine could itself be infectious for both hepatitis B and other viral infections, including AIDS. At that time, of course, the HIV had not been identified, which only increased the fears of many people. In fact, subsequent experience with the vaccine has shown that these fears were entirely unfounded.

Cost remained a factor, and early attempts were made to identify and exclude persons already having natural protective antibody (anti-HBs) who would not need the vaccine. However, it became clear that serologic screening itself was not only costly but also time-consuming. Therefore, routine pre-vaccination screening is no longer considered financially or clinically beneficial, and the vaccine should be given to all persons at risk unless, of course, they are known by history and prior serology to have natural surface antibody. Carriers will not benefit from the vaccine, nor will any harm be done if they are unknowingly given the vaccine.

While vaccine programs for health care workers have now been in place for seven years in Canada, many persons still have not had the vaccine and remain unprotected. Furthermore, HBV infection goes beyond

the occupational risk for health care workers: it is a near certainty for infants born of infected mothers. In addition, there is increasing concern for transmission of the infection on the basis of lifestyle, notably injection drug use and sexual activity. Therefore, the trend is likely to be toward vaccination of the general population at an early age — consistent with other immunization, which has been so effective in preventing infectious diseases over the past 60 years.

The surface antigen associated with the hepatitis B virus (HBsAg) is present in the serum of infected persons not only as a surface covering of the viral particle, but also as separate, small, spherical and tubular forms. The original vaccine was prepared by separating these latter non-infectious antigen particles from the larger virions, thereby creating the immunogenic stimulus essential to the development of protective antibody. However, the production depended upon physical and chemical purification methods that required more than a year to complete. This limited the amount of vaccine that could be produced and contributed to its cost. Nevertheless, the vaccine was shown to be safe and effective without serious side-effects. This plasma-derived vaccine, which became available in Ontario at the end of 1982, has provided protection to thousands of Canadian health care workers. At the same time, however, many other persons have been reluctant to have the vaccine, thus limiting its use. Some people were fearful of serious neurological side effects, perhaps recalling some of the experience associated with the swine flu vaccine a few years earlier. Others wanted to wait until more information was available, or felt that a future vaccine would be better. Pregnant women generally rejected the vaccine on principle rather than because of any known embryogenic effect.

Seroconversion — or Not

The immunization program at Toronto General Hospital began in January 1983, with vaccine sufficient for 300 persons. The number of staff at risk was greater, however, and a schedule was developed whereby various employee groups could be brought into the program over several months. Demand was tempered by the concerns already described, even among well-informed medical staff. The injections were given intramuscularly (IM) at zero, one and six months, as prescribed by the manufacturer, and the buttock was chosen as the injection site, consistent with common practice. A seroconversion rate in excess of 90 per cent had been

anticipated and was tested by obtaining serum from 107 of the early recipients; antibody levels were then quantitated using sample/negative units whereby seroconversion was considered to have occurred (positive) at the 2.1 S/N unit level. However, the predictably protective level was deemed to be 10 S/N units or greater, with values reaching more than 400 S/N units.

The results were alarming in that 18 per cent of the recipients failed to develop any antibody at all while another 14 per cent developed antibody but only between 2.1 and 9.9 S/N units, levels whose protection was considered uncertain.[5] Only 68 per cent had seroconverted to predictably protective levels. Discussions with the manufacturer revealed that although other centres in North America had experienced similar suboptimal seroconversion results, some programs had achieved seroconversion in more than 95 per cent of recipients. These variable results were contrary to the experience reported in extensive clinical trials of the vaccine and resulted in a massive effort to find an explanation. The effects of heating and cooling of the vaccine during shipping and storage were examined, as was the need to shake vials to ensure proper suspension of the vaccine prior to its administration. With these factors ruled out, a correlation was established between seroconversion and the site of injection in the buttock[6] — it had been observed that many IM injections given in this region, with needles of appropriate length, failed to reach the muscle. In many people, the vaccine was being deposited into the subcutaneous tissue overlying the gluteal musculature of the buttock. A study at McMaster University Medical Centre using simulated injections during CT scans of the pelvis confirmed that only a small percentage of injections into the buttock, intended to be IM, actually reach the muscle.[7] While a molecular explanation for this failed seroconversion is not clear, the correlation has, nevertheless, been well established. This link has resulted in the further direction from the manufacturer that injections be given IM in the region of the deltoid muscle of the arm. Hundreds of vaccine recipients have since been tested. Consistent with the clinical trials, seroconversion has occurred most of the time.

Where a recipient's pre-vaccination serology is known to be negative and seroconversion has been shown to have failed, a second course of injections is reasonable, particularly in those health care workers whose risk is clearly established. While the same vaccine can be repeated, it may be preferable to use an alternate vaccine

containing a higher antigenic concentration. Even then, however, seroconversion will not be assured, and some recipients may simply have to accept the fact of their ongoing susceptibility.

Many hospitals in Ontario have now made the vaccine available at no cost to staff considered to be at risk. These areas and groups include nursing units, ambulatory care clinics, laboratories, IV team and venipuncture technicians, respiratory therapy, surgical areas, emergency departments, intensive care units and invasive diagnostic units. The vaccine was offered initially to house-staff, but, more recently, programs have been extended to immunize medical students at the pre-clinical level. It is likely that immunization against hepatitis B will become an admission requirement to medical school. Indeed, all persons working in clinical and laboratory areas should be immunized and provision of the vaccine should be part of the hospital's occupational health and safety program. Employees in patient support and service areas such as housekeeping, maintenance trades and patient transportation should be offered the vaccine as well, notwithstanding their somewhat lesser risk.

Recombinant Vaccine

Recombinant hepatitis B vaccine became available in Canada in mid-1987 and was quickly accepted, including by many of the same persons who had rejected the earlier plasma-derived vaccine. The newer vaccine is the product of recombinant technology using yeast, and it has no association whatsoever with any infectious material. Its purity is assured, the production cycle is only 12 weeks and the supply is virtually unlimited. Recombinant vaccine is available under the brand names Recombivax-HB® (MSD) and Engerix-B® (SKF). The antigenic concentration in Engerix-B is greater (20 micrograms per mL) than in Recombivax-HB (10 micrograms per mL), but both products result in seroconversion in more than 95 per cent of recipients. With all vaccines currently available, seroconversion is slightly less likely to occur in older age groups and in persons where the vaccine is deposited in subcutaneous tissue. However, even in persons over age 50, seroconversion can be expected in more than 90 per cent of recipients. In our clinic, the first 50 persons to receive recombinant vaccine all seroconverted, with 48 developing anti-HBs levels greater than 10 S/N units. Complaints of soreness at the site of injection are essentially the same with recombinant vaccine as they were with the plasma-derived vaccine.

Post-Exposure Implications

While hepatitis B vaccination has provided a generally improved level of protection for health care workers, the management of post-exposure situations has become more complex. It requires that the injured person's anti-HBs be known or determined following the exposure. Where the anti-HBs level is well above 10 S/N units, no intervention is necessary. Where the injured person's anti-HBs is low, then a booster injection of vaccine will enhance the protective level. If the anti-HBs level is undetectable, it may simply indicate decay of prior antibody, although it may also mean that the person is in the five per cent of recipients who do not develop anti-HBs at all. This latter status will be known only if a post-vaccination anti-HBs determination was done. In its absence, and depending upon the magnitude of the exposure, some clinicians will give hepatitis B immune globulin (HBIG) as well as a booster injection of vaccine. It would seem likely that, as the years go by, the precise anti-HBs status in any individual will become less well known, even in persons who have booster injections every five years. The ultimate protection against HBV infection will then depend on the anamnestic response associated with the memory inherent in the original antibody response to the vaccine.

The rationale for booster injections lacks scientific certainty, but the recommendation in Canada generally supports the practice of booster injections at five-year intervals after the original series. It is recognized that some people will still have high levels of protective antibody at the time of the booster. However, the loss of antibody or the inability of current technology to detect it does not necessarily equate with the loss of protection. Indeed, it has been suggested that the immunologic memory is sufficiently sensitive to respond to a new stimulus, whether it be natural infection or vaccine.[8] This assumes, of course, that the offending infection is not overwhelming, as occurred in the past with HBV-infected blood transfusions.

Booster Injections

We identified seven persons whose post-vaccination anti-HBs ($>10<100$ S/N units) had become undetectable after two years. A single injection of vaccine resulted in anti-HBs levels higher than those originally attained. The same observation was made in 13 individuals whose post-vaccination surface antibody had declined to levels between 2.1 and 9.9 S/N units. These 13 in-

dividuals all showed a dramatic rise of anti-HBs in response to a single booster injection. Since it is impractical to determine routinely anti-HBs levels in the post-vaccination period and at the time of booster injection, we will have to depend on the immune memory and its response to stimulus, both viral and vaccine, for ongoing protection. Furthermore, persons who received the plasma-derived vaccine as the original series of injections may be given a booster injection of recombinant vaccine, confident that an enhanced antibody level will develop.

Conclusions

Hepatitis B vaccine should be a requirement for all health care students and graduates working in clinical or laboratory areas where it must be assumed that contact with HBV-infected blood and body substances will occur from time to time. Pre-vaccine and post-vaccine serology need not be determined routinely, but may be obtained in specific situations. The protective effect of the vaccine will be enhanced by booster injections at five-year intervals as well as in response to occult exposures.

Résumé

L'hépatite B constitue un risque professionnel pour les travailleurs des soins de santé, particulièrement pour ceux des cliniques et des laboratoires. Il existe des vaccins sans danger et efficaces, mais de nombreux travailleurs vaccinés ne sont pas immunisés et demeurent susceptibles de contracter le virus. On recommande qu'avant d'admettre un étudiant à un programme de soins de santé on obtienne une preuve d'immunité soit par vaccination, soit par infection naturelle.

References

[1]Trumbull ML, Greiner DJ. Homologous Serum Jaundice — An Occupational Hazard to Medical Personnel. J Am Med Assoc 1951; 145 (13):965–7.

[2]Scheiermann, et al. High Risk Groups for Hepatitis B Virus Infection in a University Hospital Staff. Medical Microbiol Immunol 1978; 166:241–7.

[3]Ahtone J, Goodman RA, Hepatitis B and Dental Personnel: Transmission to Patients and Prevention Issues. J Amer Dent Assoc 1983; 106:219-22.

[4]CDC Hepatitis Surveillance. HBsAg-Positive Health Care Personnel and Patient Contact. 1982; 48(June).

[5]Strickler AC, Kibsey PC, Vellend H. Seroconversion Rates with Hepatitis B Vaccine (Letter). Ann Int Med 1984; 101:564.

[6]Ukena T, Esber H, Bessette R, et al. Site of Injection and Response to Hepatitis B Vaccine (Letter). N Eng J Med 1985; 313(9):579–80.

[7]Cockshott WP, Thompson, GT, Howlett LJ, et al. Intramuscular or Intralipomatous Injections? N Eng J Med 1982; 307(6):356–8.

[8]Salk J. Personal Communication. May 21, 1987.

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Preventing and Dealing with Mass Psychogenic Illness

Summary

Mass psychogenic illness (MPI) refers to outbreaks, within a population, of symptoms that lack an identifiable biological, chemical or physical agent. The symptoms and the spread of MPI frequently follow a common pattern and are associated with a number of workplace factors and individual characteristics of workers. This article is intended to serve as a guide to recognizing, preventing and dealing with outbreaks of MPI.

Key Words: mass psychogenic illness (MPI), collective stress reaction, hysterical contagion, mass hysteria

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Introduction

Psychological factors, primarily stress and anxiety, are known to contribute to the causation of many illnesses. They can also interact with social factors, causing an outbreak of symptoms within a population even without an identifiable biological, chemical or physical agent. Such outbreaks are referred to as mass psychogenic illness (MPI). MPI most typically occurs within populations in controlled social settings, most frequently among workers in a factory or students in a school. Within the workplace, outbreaks of MPI have been recorded as early as 1787.[1] Although in most cases there is no identifiable causative agent, this fact does not mean that those affected are malingering. Symptoms are real and can be quite severe. They may include vomiting and fainting.

MPI Manifestations

Manifestations typically consist of subjective somatic complaints that cannot be confirmed by tests (e.g. musculoskeletal aches and pains, difficulty in breathing, blurred vision, nausea, dizziness, headache, weakness or sleepiness). The symptoms usually do not point to a specific cause or disease.[2]

MPI investigations indicate that outbreaks follow a common pattern.[1, 3-5] A *general triggering situation*, such as increased stress among workers, usually sets the scene for a worker to react to a *specific triggering occurrence* at work that he or she thinks might cause a disease. The presence of foul odours or the finding of insects in shipping crates or carpeting are common triggering occurrences. Under these circumstances, workers who are not in regular communication with co-workers (e.g. they do not participate in casual conversation) become dramatically ill. Co-workers note the illness, compare their own work or their general stress-induced feelings and conclude, without further verification, that these are symptoms of a disease. Symptoms then spread through a social network, with friends 'catching it' from each other. While the first workers

affected tend to be the persons with few social contacts, the later ones tend to have more social contacts at work.

Factors to be Considered in MPI

Workplace Factors

Workplace factors that direct workers' attention to their own physical and mental states may include repetition or monotony in jobs, lack of social interaction on a job and stress and anxiety on and off the job. Outbreaks have been associated with poor worker-management relations,[6] role or status incongruities[7] or daily and financial pressures.[8] More specific triggering situations reported include poor lighting or temperature,[9] overcrowding,[10] loud noise[11] and fear of chemical intoxication.[12]

Workers' Characteristics

Studies of MPI have identified a number of personal characteristics that are associated with susceptibility to MPI. The following are the most commonly observed:

Stress Coping Style
Workers who have a history of reacting to stress by somatization are usually affected.[13] However, others who usually deny any symptoms may suddenly demonstrate severe symptoms.

Social Status
Social-demographic factors reflecting low social status (e.g. low-status jobs) are associated with individual susceptibility.[1, 2]

Gender
Eighty-nine per cent of the workers reported to be affected in MPI studies have been women.[8] While this statistic is striking, to some extent it reflects that it is women who tend to be in low-status jobs. There is also evidence to suggest that this finding is, in part, due to the considerable stress at home and on the job that women often experience.[7, 14]

Sociability
Lack of social contact at work increases susceptibility to MPI.[4]

Preventing MPI

To prevent MPI, management and the joint health and safety committee (JHSC) should develop programs that

deal with both general and specific triggering factors. For example, stress management courses may prevent stress as a general triggering factor while Workplace Hazardous Materials Information System (WHMIS) training can avoid specific triggers associated with the presence of hazardous materials (e.g. strange odours). The following are recommendations as to what can be done by management, joint health and safety committees and occupational health professionals.

Management should improve any poor labour relations that render workers with feelings of helplessness. This action may avoid workers' perceptions that demonstrating symptoms of illness is a way of gaining a sense of control over their work situation.

Management and the JHSC should involve workers in reviewing workplace conditions that may trigger MPI. Doing this in terms of the dynamics of MPI will help implement the prevention programs. For example, outbreaks are more common when workers are prevented from communicating on the job because of noise or a regimented break-time scheduling. The observation of a dramatic symptom may serve as an excuse to break the regime and make social contact with co-workers, which in turn may result in undue attention given to the observed symptoms. To avoid this problem, noise should be minimized, restrictions on communication relaxed, or alternative and appropriate means be provided so that co-workers can satisfy their needs for social interaction.

Management and JHSC should train workers to be aware of the types of sensations they may experience (e.g. soreness, fatigue, drowsiness) as a result of doing their jobs. More generally, they should establish programs, such as stress management courses and wellness and employee-assistance programs, to deal with employee stress.

On occasion, workers are exposed to what may be hazardous biological, chemical or physical agents. If this occurs, management and the JHSC should inform workers if significant poisoning or sickness is possible.

Occupational health professionals and management should provide greater attention to individuals who tend to be in social isolation, particularly during times of stress. These individuals should be informed that the various symptoms they might experience are common and temporary.

Occupational health professionals and management should monitor and prevent stressful working conditions that may trigger symptoms. Particular attention

should be given to those workers who are known to be predisposed to symptoms due to health conditions (e.g. coronary heart disease).

Management and the JHSC should take prompt action when workers voice their concern over an unusual occurrence (e.g. a peculiar smell of unknown origin), especially when the working conditions are already stressful. Workers should be reassured that immediate actions are being taken to identify and deal with the potential problem.

Recognizing MPI and Dealing with Outbreaks of MPI

In cases where biological, chemical or physical agents do not seem to account for symptoms, an investigation should be conducted to determine if the manifestations of the symptoms, the workplace factors and the characteristics of the affected workers are consistent with MPI. The information provided in this article should be used as a guide for interviewing the affected workers, their co-workers and others who may have information relevant to the outbreak. Even though the results may be consistent with MPI, the search for other causes of the symptoms should continue. This is necessary both to confirm the conclusion that MPI is responsible for the symptoms (by the exclusion of other factors), and to assure workers that their concerns are being taken seriously.

Management and occupational health professionals should immediately attend to concerns raised regarding workers' observable symptoms at work. They should also provide prompt explanations, indicating whether the problem is or is not directly related to workplace conditions.

Management and occupational health professionals should avoid being unduly influenced by media coverage. In cases where the cause of symptoms is unknown, such coverage often adds to the desire to form conclusions that may be premature. Actions and comments should be based upon current scientific understanding.

If occupational health professionals can maintain workers' confidence in them, they will encourage most workers to separate themselves from a few who continue to believe that they may have a serious disease. The majority of workers can then help assure the fewer co-workers that the symptoms being experienced are temporary and psychogenic. Occupational health professionals can gain workers' confidence by:

1. convincing workers that the health professional's first responsibility is to them;
2. advising workers, as soon as possible, that they do or do not have an identifiable disease, as confirmed by appropriate diagnostic laboratory findings; and
3. advising workers that although others do have symptoms, these symptoms will likely diminish and disappear in time since there is no objective evidence of a disease that would prolong such symptoms.

While calling in experts and/or media may often serve to clarify a situation, their involvement may also contribute to the fears of workers, and so add to their anxieties. Management and occupational health professionals should not, of course, hesitate to call in experts or media when they feel it is appropriate; yet consideration should be given to how their appearance may negatively influence the workers.

Attending medical professionals and other experts should avoid reinforcing unwarranted fears and anxieties by expressing vague comments or providing unnecessary or unusual treatments.

Conclusions

In a recent study of telephone operators experiencing symptoms for which no physical agent could be found, it was noted that the role of occupational stress and psychosocial factors in contributing to their reported symptoms were trivialized and ignored.[15] This resulted in unnecessary expense, disruption in service and months of heightened anxiety and frustration for the operators.

This article has reviewed the dynamics by which stress and psychosocial factors may result in outbreaks of MPI. Included are commentaries on the role of associated antecedent workplace conditions and personal characteristics of susceptible workers in contributing to these outbreaks. This can help management, JHSCs and occupational health professionals to prevent and/or minimize the occurrence of MPI. Central to prevention of MPI is the maintenance of good labour relations, so that workers will feel that management, the JHSC, and the occupational health professionals respect and properly attend to their health and safety concerns. Management and the joint health and safety committee should also develop prevention programs to help avoid both general and specific factors known to trigger MPI.

Résumé

L'expression 'maladie psychogène des masses' (MPM) s'applique à l'éclosion, dans une population, de symptômes dus à un agent biologique, chimique ou physique non identifiable. Les symptômes et la propagation de la MPM ont couvent une évolution similaire et sont liés à divers facteurs présents dans le lieu de travail et à des caractéristiques personnelles des travailleurs. Cet article servira de guide pour reconnaître et prévenir les MPM et à prendre les mesures qui s'imposent.

References

[1]Brodsky CM. The psychiatric epidemic in the American workplace. Occup Med: State of the Art Reviews 1988; 3:653–62.

[2]Colligan MJ, Murphy LR. A review of mass psychogenic illness in work settings. In: Colligan MJ, Pennebaker JW, Murphy LR (eds): Mass Psychogenic Illness: A Social Psychological Analysis. Hillsdale, NJ: Lawrence Erlbaum Assoc, 1982.

[3]Kerckhoff AC. A social psychological view of mass psychogenic illness. In: Colligan MJ, Pennebaker JW, Murphy LR (eds): Mass Psychogenic Illness: A Social Psychological Analysis. Hillsdale, NJ: Lawrence Erlbaum Assoc, 1982.

[4]Singer JE, Baum CS, Baum A, Thew BD. Mass psychogenic illness: The case for social comparison. In: Colligan MJ, Pennebaker JW, Murphy LR (eds): Mass Psychogenic Illness: A Social Psychological Analysis. Hillsdale, NJ: Lawrence Erlbaum Assoc, 1982.

[5]Watson DL, deBortali-Tregerthan G, Frank J. Social Psychology: Science and application. Glenview, Ill.: Scott, Foresman, 1984.

[6]Colligan MJ. An investigation of apparent mass psychogenic illness in a furniture plant. Unpublished NIOSH evaluation report (1978) . . . cited in Rodin J: The application of social psychology. In: Gardner L, Aronson E, (eds). The Handbook of Social Psychology. 3rd ed. New York: Newbery Awards Records, Inc, 1985: 805–81.

[7]Kerckhoff AC, Back KW. The June Bug: A Study of Hysterical Conversion. New York: Appleton-Century-Crofts, 1968.

[8]Colligan MJ, Murphy LR. Mass psychogenic illness in organizations: An overview. J Occup Psychol 1979; 52:77–90.

[9]Colligan MJ, Urtes M. An investigation of apparent mass psychogenic illness in an electronics plant. Unpublished NIOSH evaluation report (1978) . . . cited in Rodin J: The application of social psychology. In: Gardner L, Aronson E (eds): The Handbook of Social Psychology, Third Edition. New York: Newbery Awards Records, Inc, 1985: 805–81.

[10]Freedman J. Theories of contagion. Paper presented at American Industrial Hygiene Conference, Chicago, 1979 . . . cited in Rodin J: The application of social psychology. In: Gardner L, Aronson E (eds): The Handbook of Social Psychology, Third Edition. New York: Newbery Awards Records, Inc, 1985: 805–81.

[11]Shepard RD, Kroes WH. Report of an investigation at the James plant. Internal report prepared for the National Institute for Occupational Safety and Health Cincinnati, Ohio, 1975 . . . cited in Rodin J: The application of social psychology. In Gardner L, Aronson E (eds): The Handbook of Social Psychology, Third Edition. New York: Newbery Awards Records, Inc, 1985: 805–81.

[12]Kutz PH, Esser TE, A variant of mass (epidemic) psychogenic illness in the agricultural work setting. J Occup Med 1989; 31:331–4.

[13]Smith JJ, Colligan MJ, Hurrel JJ Jr. Three incidents of industrial mass psychogenic illness. J Occup Med 1978; 29:399–400.

[14]Hall EM, Johnson JV. A case study of stress and mass psychogenic illness in industrial workers. J Occup Med 1989; 33:243–50.

[15]Yassi A, Weeks JL, Samson K, Raber MB. Epidemic of 'shocks' in telephone operators: Lessons for the medical community. CMAJ 1989; 140:816–20.

Peter Taylor

Nuclear Emergency Planning and Response

Summary

The Radiation Protection Service (RPS), which is part of the Health and Safety Support Services Branch, has a broad mandate within the field, as is implicit in its title. Not all programs delivered by the RPS are occupational health oriented. This article describes the involvement of the RPS in the field of planning and response in the context of a nuclear reactor accident.

Key Words: nuclear emergency, emergency planning, civil emergency

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Background

What, you may ask, does nuclear emergency planning and response have to do with occupational health in Ontario? The answer is, 'not very much' — except, possibly, to the workers at the accident site, which is an area of federal jurisdiction.

The subject does, however, have quite a lot to do with the Radiation Protection Service (RPS), which plays an important role in the event of a nuclear emergency. Planning for and responding to the off-site effects of a release of radioactivity from a nuclear reactor is one of a number of 'non-occupational' activities undertaken by the RPS. Before dealing with the part played by the RPS in such an incident, however, some background should prove useful.

The mode of response in Ontario to an accident at a nuclear reactor is set out in 'The Province of Ontario Nuclear Emergency Plan', a document produced by the Emergency Planning Office of the Ministry of the Solicitor General. This is the 'lead ministry' for nuclear emergency planning, although historically responsibility has passed from ministry to ministry.

The first provincial nuclear emergency plan was produced in 1975 by the Ministry of Health, at that time the appropriate ministry because of the relevant expertise of its Radiation Protection Service. In 1977 the RPS was transferred to the Ministry of Labour, and with it the responsibility for nuclear emergency planning. In 1982 the Ministry of the Solicitor General (MSG) created the office of Emergency Planning Ontario (EPO), the purpose of which was to co-ordinate general emergency planning and to assume the lead in nuclear planning. After a number of revisions of the original plan, the EPO, in consultation with Ontario Hydro and numerous provincial and municipal agencies, produced the current Provincial Plan.

The Provincial Plan consists of a master plan and eight subsections. The master plan describes the planning concepts used and outlines the general mode of response to a nuclear accident. It also lists in some detail the responsibilities of each participating agency,

including the Ministry of Labour. Annexed to the master plan are several sections, each containing material specific to a nuclear site in Ontario or a neighbouring U.S. state.

Basic Planning

In order to describe the part played by the RPS in nuclear emergency planning and response, some of the basic planning concepts must first be explained. To simplify response planning, the area around the incident site is divided into two main zones, primary and secondary. The primary zone extends out from the reactor to a radius of 10 km and is divided into a series of sectors, usually between 20 and 30. These sectors are not regular or geometric in shape, but are defined by geographical features such as roads, railway tracks or streams. This system simplifies the identification of areas for implementing protective measures such as evacuation, or for contamination monitoring.

The secondary zone, which is much larger in area, extends to a radius of 50 km from the reactor. The incident is also divided into two response phases.

Phase 1, the initial phase, extends from the activation of the emergency plan to the point at which the nuclear reactor has been safely shut down and an unplanned release of radioactivity is unlikely. This phase could last from a few hours to a few days. The off-site operations carried out in Phase 1, particularly in the early stages, are mainly concerned with an assessment of the nature and scale of the incident and with the protection of the population from the effects of any radioactivity released. The irradiation pathways of concern here are external exposure to the plume, or contamination, deposited from it, and inhalation of radioactive material.

Phase 2 starts at the end of Phase 1 and continues until a state of near normalcy is achieved. Two modes of response take place in this phase: ingestion monitoring, and restoration. Restoration operations concentrate on getting things back to normal. Typical actions include rescinding any restrictions imposed in the early stages, arranging for the return to their homes of any evacuees and assessing appropriate compensation. Ingestion monitoring, the other mode of response, involves the RPS.

Ingestion Monitoring

The purpose of ingestion monitoring is to assess the impact of a radioactive release upon the food chain, so that steps can be taken to minimize the risk to the population. The Ingestion Monitoring Organization

(IMO) is responsible for planning and executing ingestion-monitoring operations. It is a multi-agency body composed of personnel from the Ministry of Labour, the Ministry of the Environment, the Ministry of Agriculture and Food and Ontario Hydro. The Ministry of Labour has the task of co-ordinating the IMO, preparing operational procedures and providing the equipment and administrative support needed to sustain operations in the field.

The first task of the IMO is to produce an appropriate plan for sampling the food chain. This plan is devised by the Ingestion Monitoring Control Group (IMCG) and implemented by the Field Headquarters Unit, an RPS team that will set up a base close to the affected area. From this location, teams from the ministries of the Environment and Agriculture and Food are despatched to collect the food samples for analysis. These samples are either sent to the RPS lab in Toronto or analysed at field headquarters. Based upon the results, either the IMCG may ask for further sampling or protective measures may be enforced.

An Illustration

To give a clearer picture of these emergency response operations, we will consider what would happen in the event of an accident at a nuclear reactor site in Ontario.

As soon as sufficient information is available, the Province (with the Ministry of the Solicitor General as lead ministry) will decide whether the Provincial Plan should be activated. Assuming that it is, the next step is to initiate a number of chains of notification (alert lists). In this procedure, the head of each agency involved in the response is informed of the situation and, in turn, starts the notification chain for his or her response group. Groups whose input and authority are required from the earliest stages of the emergency will go at once to the Provincial Operations Centre (Opscentre) in Toronto. One such group is the Technical Group, which analyses the situation and advises on measures to protect the public. Another is the Operations Group, which possesses the authority to implement these measures. Others, whose services are not needed immediately, either remain on standby or start preparing for deployment. In the case of the IMO, the head of the Ingestion Monitoring Control Group (an RPS position) calls his or her contacts on the IMO alert list and heads for the Opscentre. The first calls are to two fellow IMCG members (one from Environment, the other

from Agriculture and Food), telling them that they will be needed at the Opscentre. Also called is the acting chief of the RPS lab, who is alerted of the possibility of incoming samples, and the head of field operations, whose task is to prepare the Field Headquarters (FHQ) Unit for deployment.

The FHQ Unit includes a communications/office trailer and a fully equipped mobile radio-analytical laboratory based on a 23-foot Winnebago motor home. The trailer, which acts as an operations and communications centre, carries all monitoring and protective equipment needed to sustain the field operations. (The FHQ, which is supplied, equipped and maintained by the Ministry of Labour, is entirely staffed by RPS personnel.) Upon being alerted, the FHQ team assembles at the Resources Road lab and loads the mobile lab with radios, clothing, instruments and so on. Meanwhile, the Ministry of Government Services, which houses and transports the trailer, is notified so that it can arrange for transportation to the affected area.

Back at the Opscentre, the IMCG has been observing the progress of the incident and preparing for the moment when the deployment of the IMO is indicated. As soon as this decision is made, the FHQ Unit is notified and all personnel and vehicles head out to the affected area — to one of three or four pre-arranged sites that will be the base of field operations.

Each site has its own dedicated telephone line, and the first action upon the arrival of the team is to make contact with the IMCG at the Opscentre. Information is exchanged, and any requests for field sampling will be recorded. While this is taking place, the FHQ team is making the FHQ operational: levelling and jacking the trailer, starting the auxiliary electric generator, erecting the 55-foot antenna tower and testing the radios and radio-telephone, among other tasks. Maps and manuals will be put out, monitoring instruments tested, signs erected and the site marked for parking, sample receiving, contamination control and so on.

When the trailer is operational, the team starts work on the mobile lab. Meanwhile, samplers from the ministries of the Environment and Agriculture and Food, arriving on-site, have been logged and taken to the trailer for briefing on the sampling requirements, if already requested, and on the use of the instruments and safety gear issued to all field personnel. During this briefing, other FHQ team personnel have been installing two-way VHF radios in the cars of the sampling teams. After a quick run-through of radio procedures,

the teams depart on their sampling missions. The samplers periodically report in by radio, and the duty officer at FHQ plots their positions on a wall map in the trailer.

Surveyors from Ontario Hydro are also part of the FHQ complement. They act as radiation safety advisers, assist with contamination control and, if required, carry out field surveys of ground contamination. When the sample teams return to FHQ, they and their vehicles are checked for contamination, and the samples, which could be milk, water, vegetation, fruit or any other foodstuff, are either passed on to the mobile lab for analysis or put aside for transportation to the RPS lab in Toronto. The duration of these ingestion control operations would depend upon the nature and severity of the release, and could range from days to months.

The later stages of Phase 2 would involve sampling much farther from the reactor. The contamination levels would decrease with distance, and the degree of urgency would be reduced. This would allow the FHQ to be dismantled and the sampling directed from Toronto, through the appropriate regional offices of the Ministries of the Environment and Agriculture and Food, until a decision is made to suspend operations entirely.

Background Data

In order to assess accurately the impact of a radioactive release upon the environment, the food chain and, thus, the public, one must have information on the pre-incident levels. This introduces another non-occupational task undertaken by the RPS: the routine collection of data on background levels of radioactivity in various media throughout Ontario. In one program the RPS maintains 100 sites in southern Ontario, at which measurements of gamma radiation are made. Another program is operated in conjunction with the ministries of the Environment and Agriculture and Food, which send a wide range of samples to the RPS lab for analysis. This collaboration provides a database of the radioactive content of air, water, milk and other components of the food chain. These records, which span a period of many years, would be invaluable to ingestion-monitoring operations and in the assessment of the environmental and public health impact of a release from a reactor. In 1987, when the plume from the Chernobyl reactor accident reached Canada, the levels of radioactivity were measurable but very low. The use of the background data allowed the RPS lab to provide a more accurate estimation of the fallout.

Conclusion

In conclusion, it is hoped that this article has shed some light on two of the less obvious functions of the Radiation Protection Service. There are other examples of non-occupational duties within the broad spectrum of RPS programs carried out by the service. These will be the subject of a future article.

Résumé

Le Service de protection contre les radiations qui fait partie de la Direction des services de soutien à la santé et à la sécurité au travail a reçu un mandat très général comme on peut le déduire de son titre. Tous les programmes du S.P.R. ne concernent pas nécessairement la santé au travail. Cet article décrit comment le S.P.R. participe à la planification et aux mesures à prendre dans le cadre d'un accident à un réacteur nucléaire.

Recent Publications Available From the Government Book Store

Regulations	Workplace Hazardous Materials Information System — made under the Occupational Health and Safety Act Ontario Regulation 644/88
	Hazardous Materials Inventories — made under the Occupational Health and Safety Act Ontario Regulation 643/88
Support Literature	Workplace Hazardous Materials Information System (WHMIS): A Guide to the Legislation
	Factors Modifying Lung Cancer Risk in Ontario Uranium Miners
	Waste Anaesthetic Gas Exposure in Veterinary Hospitals Hazard Alert
	Policy and Guidelines in Dealing with AIDS and HIV Infections
	Regulating Hazardous Substances in the Workplace — Joint Steering Committee pamphlet
	Occupational Health and Safety Act Interpretation and Opinions

Coming Events

March 14–16, 1990	Focus on the Future: A National Conference on the Challenge of Health and Safety. CALGARY, ALBERTA, CANADA. For further information, contact: Alberta Hospital Association, Education Services, 1009–108 St., Edmonton, Alberta, Canada, T5J 3C5. Telephone: 403/423-1776, Ext. 408.
March 20–22, 1990	Engineering a Quieter Europe. BIRMINGHAM, ENGLAND. For further information, contact: Julie Brown, Conference Dept. C406, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ, England. Telephone: 01-222 7899, Ext. 237.
April 3–6, 1990	BOHS Annual Conference. YORK, ENGLAND. For further information, contact: BOHS, 1 St. Andrew's Place, Regent's Park, London NW1 4LB, UK. Telephone: 01-486 4860, FAX: 01-224 2576.
April 24–26, 1990	Indoor Air Quality and Ventilation in Warm Climates. LISBON, POSTUGAL. For further information, contact: Secretariat, International Indoor Air Quality and Ventilation Conference, British Occupational Hygiene Society, 1 St. Andrew's Place, London NW1 4LB, England. Telephone: 01-823 9401.
May 6–11, 1990	Twelfth World Congress on Occupational Safety and Health. HAMBURG, FRG. For further information, contact: Hamburg Messe und Congress GmbH, Postbox 302480, D-2000 Hamburg 36, Federal Republic of Germany.
May 13–18, 1990	American Industrial Hygiene Conference. ORLANDO, FLORIDA, U.S.A. For further information, contact: AIHA, 475 Wolf Ledges Parkway, Akron, OHIO, U.S.A. 44311. Telephone: 216/762-7294.

May 17–19, 1990	Ninth International symposium on contact dermatitis. STOCKHOLM, SWEDEN. For further information, contact: Professor Jan E. Wahlberg, Contact Dermatitis, 1190, Karolinska Hospital, S-104 01 Stockholm, Sweden.
May 20–23, 1990	FUTURESCOPE 90, GOLD COAST, AUSTRALIA. For further information, contact: National Safety Council of Australia Congress and Exposition, C/-Pacific Rim CONVENTION Systems Pty. Ltd., G.P.O. Box 853, Brisbane, Queensland, Australia, 4001. Telephone: 07/221 2762, FAX: 07/220 0231.
May 20–24, 1990	World Conference on Lung Disease. BOSTON, MASSACHUSETTS, U.S.A. For further information, contact: NIOSH/OPPE, Building 1, Room 3040, Mailstrop D29, U.S.A.
June 12–15, 1990	Twenty-First National Meeting on Occupational Medicine. ROUEN, FRANCE. For further information, contact: Dr. Alain Poirier, President, or Dr. M. Gournay or Dr. M. Monfrin, Vice-Presidents, Comité d'Organisation des XXIèmes Journées Nationales de Médecine du Travail, 22, rue Guy de Maupassant, BP 538, 76005 Rouen Cédex. Telephone: 35.71.85.90.
June 19–23, 1990	Sixth International Conference on AIDS, SAN FRANCISCO, CALIFORNIA. For further information, contact: c/o NIOSH/OPPE, Building 1, Room 3040, Mailstrop D29, U.S.A.
July 2–6, 1990	Society of Occupational Medicine. EDINBURGH, SCOTLAND. For further information, contact: SOM, 6 St. Andrew's Place, Regent's Park, London, England, NW1 4LB. Telephone: 01-486 2641.
July 29–August 3, 1990	Fifth International Conference on Indoor Air Quality and Climate. TORONTO, ONTARIO, CANADA. For further information, contact: Centre for Indoor Air Quality Research, University of Toronto, 223 College St., Toronto, Ontario, Canada, M5T 1R4.
August 12–16, 1990	Human Aspects of Advanced Manufacturing and Hybrid Automation. HONOLULU, HAWAII, U.S.A. For further information, contact: Hilton Hawaiian Village, Honolulu, Hawaii, U.S.A.

September 10–14, 1990	Minesafe International 1990. PERTH, WESTERN AUSTRALIA. For further information, contact: The Secretary, The Chamber of Mines and Energy of Western Australia (Inc.), 7th Floor, 12 St. George's Terrace, Perth, Australia, 6000. Telephone: (09) 325 2955, FAX: (09) 325 4562, Telex: AA92792.
September 22–28, 1990	Twenty-third International Congress on Occupational Health. MONTREAL, QUEBEC, CANADA. For further information, contact: Dr. M. Lesage, Chairman of the Organizing Committee, 84 rue de Brésoles, Montréal, Québec, Canada, H2Y 1V5.
December 2–5, 1990	Australian Institute of Occupational Hygienists Conference 1990. PERTH, WESTERN AUSTRALIA. For further information, contact: c/o Government Chemical Laboratories, William St., Brisbane, Queensland, Australia, 4000.
March 4–7, 1991	Toxic Metal Compounds (interrelation between chemistry and biology). LES DIABLERETS, SWITZERLAND. For further information, contact: Dr. Ernest Merian, Im Kirsgarten 22, CH-4106 Therwill, Switzerland.

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